To Splat Straight with Crooked Points:

Rendering Noisy Meshes and Point Clouds using Coherent Tangent Vector Fields

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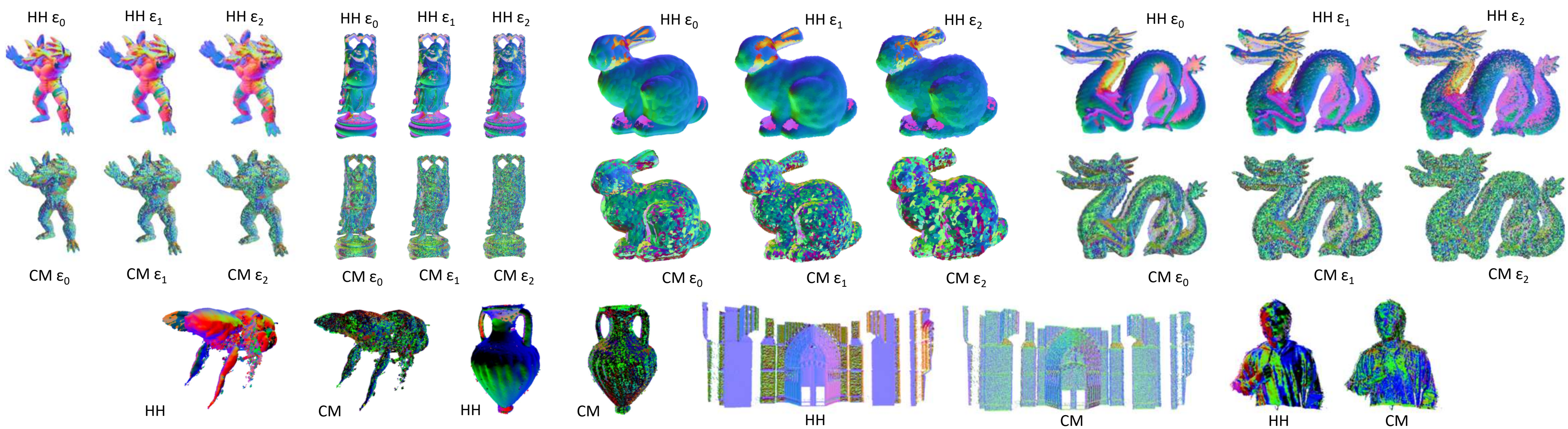

Splatting with tangent vector fields

In this work we compare two surface aligned splatting techniques to render noisy mesh and point cloud data. The first technique consists of applying the Householder (HH) formula (Lopes et al., 2013) to generate locally and globally coherent tangent vector fields given the normal vector field of a point cloud or mesh, thus, generating coherent splat orientations. The second technique consists of the standard Covariance Matrix (CM) approach that aligns splats according to the direction of minimal curvature.

We evaluated both techniques using four publicly available meshes with synthetic noise, and four scanned point clouds with natural noise.

(Table 1) shows the local angular deviation using HH that is considerably smaller than the values obtained with CM.

In both low and high noise scenarios:

- HH can represent small detail, while CM shows increasing variations in tangent vector directions even in close neighborhoods where similar normal vectors are expected;
- CM creates more holes between splats.

References

Lopes et al., 2013, Tangent vectors to a 3-D surface normal: a geometric tool to find orthogonal vectors based on the Householder transformation. Comput. Aided Des. 45, 3, 683–694.

Table 1 - Local angular deviations of the tangent vector fields. Each line lists the values for HH or CM for increasing noise levels.

Model	Armadillo	Buddah	Bunny	Dragon	Bee	Vase	Cathedral	Male
Nº points	172.973	540.227	35.946	437.420	188.278	147.420	576.064	146.963
HH ε_0	3.89 2.29,7.62	5.12 2.43,9.94	3.94 2.31,8.26	4.13 2.30,7.88	4.58 2.22,11.49	2.87 1.77,4.96	5.13 1.06,18.67	6.5 3.04,15.96
CM ε_0	38.54 17.03,63.35	35.399 15.49,57.89	29.43 13.04,50.56	39.28 16.73,63.28	43.48 19.73,68.12	35.26 15.06,59.01	29.05 12.74,49.37	31.01 14.28,51.95
HH ε_1	5.06 3.18,9.45	7.95 4.79,14.75	4.24 2.56,8.63	8.42 5.26,14.77	- -	- -	- -	- -
CM ε_1	44.52 20.06,69.69	35.61 15.74,58.06	39.79 18.61,62.77	45.34 21.54,68.95	- -	- -	- -	- -
HH ε_2	8.35 5.31,15.52	13.03 7.6,26.13	5.43 3.46,10.32	23.56 13.43,41.78	- -	- -	- -	- -
CM ε_2	45.57 21.44,70.07	35.86 15.99,58.35	44.64 20.57,68,89	57.10 31.12,78.06	- -	- -	- -	- -